The Bay Area Verbal Learning Test (BAVLT)

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Introduction

Verbal learning tests are sensitive measures of decline in pre-clinical Alzheimer's disease, with recall scores correlating with amyloid and tau burden [1]. Here, we describe a digital version of the Bay Area Verbal Learning Test (BAVLT) [2], which is a **brief, fully automated verbal learning test** that is remotely given in either the lab or the home and is scored using advanced automatic speech recognition. Remote administration and automatic scoring allows for rapid and objective assessment, as well as increased accessibility. We present here data from the performance of healthy adults, with a concentration on age, gender, vocabulary and the excellent psychometric properties of the BAVLT.

Methods

Participants: The BAVLT was administered to 438 healthy adults. ~ 42% of participants were female, with a mean age of 64.8, ±14.5

Technology: Participants were tested using a tablet computer with circumaural headphones and head-mounted microphone. Instructions and stimuli were delivered using text-to-speech (TTS) with intensities adjusted to the participant's auditory threshold. Responses were **automatically scored using consensus automatic speech recognition (CASR)** with performance scores displayed in real time. An examiner remotely monitored participant performance over audio and visual feeds.

Task: Participants were instructed to remember two lists — each with 12 words in four semantic categories. List A was presented three times with immediate recall after each presentation, followed by a single presentation and recall of distractor List B, then an un-cued recall of List A. Thirty minutes later, participants completed a List A delayed recall, followed by a 2-choice List A recognition test. Audio responses were recorded and scored using CASR.

Bay Area Verbal Learning Test (BAVLT)
Test Structure
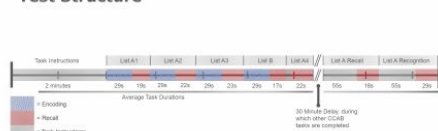
Key Properties

- Remote administration
- In-home or in-lab testing
- Automatic test presentation using TTS
- Automatic scoring with Consensus ASR
- Brief (~8.5 minutes for both test administration and scoring)
- Easy large-scale testing during pandemic conditions

Summary

The BAVLT demonstrated excellent test-retest reliability:
r = .86 for total recall
r = .74 for delayed recall

Learning effects increased performance on Day 2 by ~ 1 standard deviation

A regression model including age, gender, and vocabulary size accounted for 38.4% of the variance
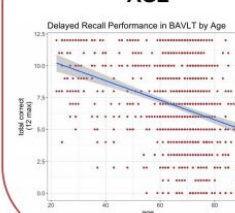
- Female participants had higher recall scores
- Increased age resulted in decreased recall scores
- Higher vocabulary scores predicted better recall

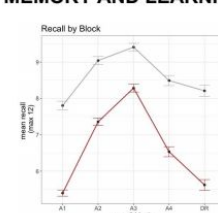|	B	SE	t-value	LL 95%	UL 95%	p-value
Gender***	10.11	1.66	6.08	6.84	13.39	<.001
Age***	-.63	.06	-10.57	-.74	-.51	<.001
Vocabulary* **	1.55	.11	9.96	.85	1.26	<.001

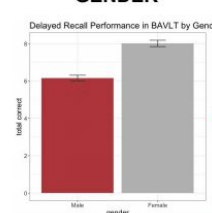**See BAVLT demo at booth 1000**

Results

AGE   MEMORY AND LEARNING   GENDER

Discussion

Our results are consistent with previous laboratory-based assessments, and indicate that the brief, tele-medically administered BAVLT is a sensitive metric of verbal learning with excellent psychometric properties.

Vocabulary size, age, and gender are strong predictors of BAVLT recall performance among healthy adults. Robust learning effects surfaced during Day 2 recall.

The high test-retest reliability of the BAVLT demonstrates that automated memory recall tests can be reliable and accurate, even when remarkably brief. Monitoring via an integrated telemedical interface assures the quality of remote assessments and enables large-scale testing even during pandemic conditions.

References

[1] Bejanin et al. (2017) DOI: https://doi.org/10.1093/brain/awx243
[2] Woods et al (2017) DOI: https://doi.org/10.3389/fnhum.2016.00654

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